



DAVID CROCKETT STATE PARK

GREEN CABINS EDUCATION MANUAL



Jed DeKalb



Jed DeKalb



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David Crockett State Park

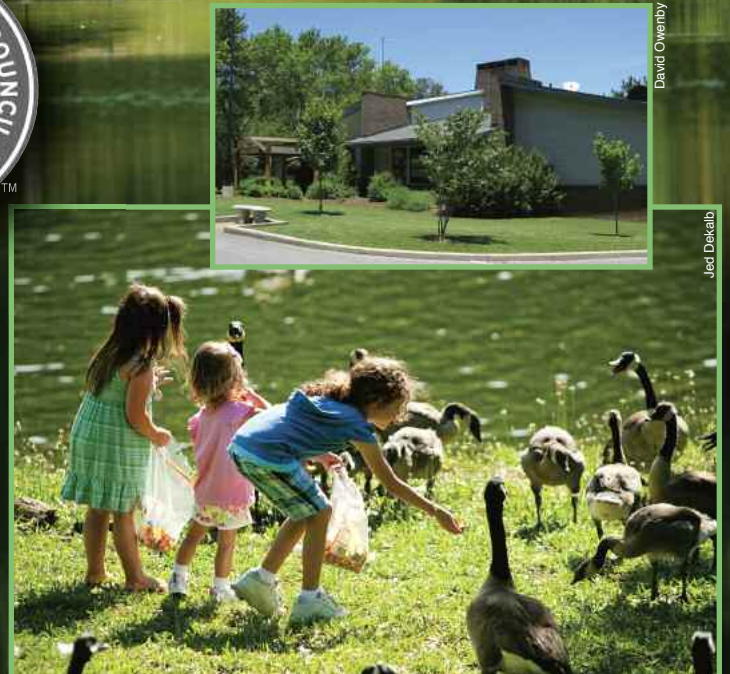
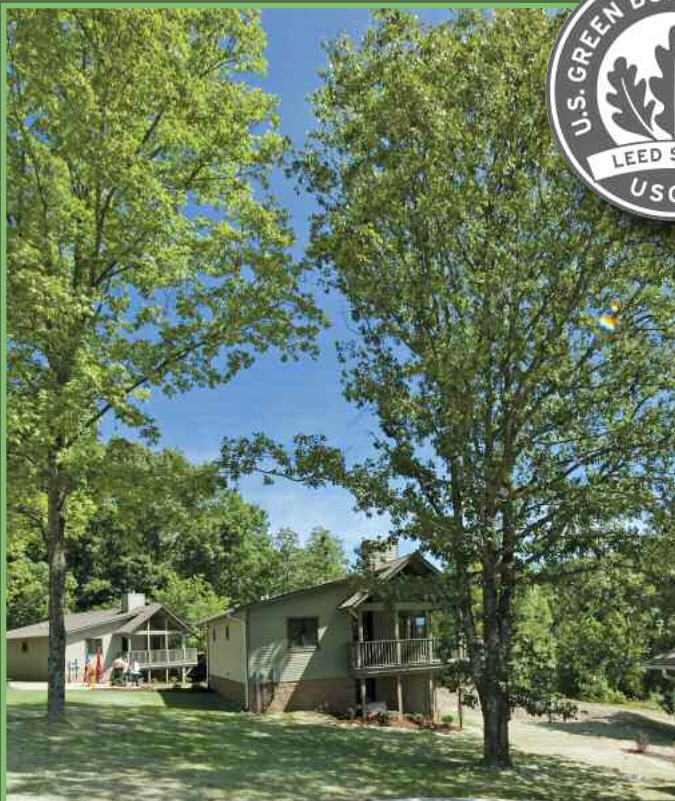


Jed Dekalb



David Owensby

David Crockett State Park honors the famous pioneer, soldier, politician and industrialist who spent considerable time in Lawrence County. Today, this park celebrates Crockett's frontier spirit with an award-winning geothermal system supporting its restaurant and seven new cabins along Lindsey Lake. These beautiful, environmentally friendly cabins were designed and built to be the first LEED Silver certified vacation homes in any state park. We think David would have liked it this way.



Jed Dekalb

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tnstateparks.com/DavidCrockettSP

To our Guests at David Crockett State Park,

Over the past seven years, Tennessee State Parks have been recognized as leaders in water conservation, energy efficiency, renewable energy and recycling. Our parks have deployed energy efficiency and lighting packages and were early adopters in purchasing renewable energy from TVA's Green Power Switch Program. We even have three golf courses on the Tennessee Golf Trail certified as Audubon Cooperative Sanctuaries, and these three courses were also the first certified Groundwater Guardian Green Sites in the entire state.

A capstone for our department's sustainability efforts occurred this summer with the opening of seven new cabins at David Crockett State Park in Lawrenceburg. These two-bedroom, two bathroom cabins demonstrate how to lessen the environmental impact of a home, both during and after construction, by incorporating proper storm water construction management, geothermal heating and cooling, high performance water devices and high efficiency appliances. They are also the first U.S. Green Building Council LEED Silver certified vacation homes for any state park system in the nation.

While we started the David Crockett Green Cabins project with a clear vision, the department could not have achieved such a successful outcome without our project partners: the U.S. Environmental Protection Agency, TVA, Hastings Architecture Associates, LLC, Carvell Construction and the CFP Group, LLC. The positive working relationship between partners was critical in creating these unique and beautiful accommodations at David Crockett.

These new vacation cabins reflect our system-wide commitment to sustainable building practices, pollution prevention and education about conservation-oriented ideas park visitors can incorporate into their own home and lifestyle. This Education Manual is designed to share the elements of sustainable design, construction and operation that can work at your house to benefit your family, community and the environment.

We trust your experience at David Crockett State Park is a positive one, and I hope you take an idea or two on sustainable design home with you. Enjoy our good nature and these exceptional cabins.

Jim

TDEC Commissioner Jim Fyke (with scissors) was joined by a host of state and local officials on June 7, 2010 to dedicate seven new beautiful and environmentally friendly cabins at David Crockett State Park in Lawrenceburg. Front Row (l to r): Mike Carlton, Assistant Commissioner for Tennessee State Parks Operations; Henry Phillips, DCSP Park Manager; Commissioner Susan Whitaker, TN Department of Tourist Development; Jane Gay Carvell, Carvell Construction; State Senator Doug Jackson; Ametra Bailey, Former Lawrence County Mayor; TDEC Commissioner Jim Fyke, TDEC Deputy Commissioner Paul Sloan; Jim Hastings, Hastings Architecture Associates. Back Row (l to r): Kent Carvell, Carvell Construction; Daniel Webb, Lawrence Co. Chamber of Commerce; Mayor Keith Durham, City of Lawrenceburg; Mark Zook, Hastings Architecture Associates; David Bailey, Hastings Architecture Associates; Andy Lyon, Assistant Commissioner for Tennessee State Parks Hospitality Services.



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BACKGROUND

The Tennessee Department of Environment and Conservation's vision is to make our state a model of environmental stewardship. Consistent with that vision, TDEC committed to build seven new cabins at David Crockett State Park in a manner that incorporated Tennessee Valley Authority Energy Right® Solutions Technologies, U.S. Environmental Protection's ENERGY STAR certification and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) approach to construction. Part of this commitment also included creating a meaningful learning opportunity on sustainable design, construction and operation for our guests that stay in these new vacation homes.

This comprehensive green building project began in 2008 with EPA providing resources for education, TVA providing consulting on geothermal installation and energy efficient construction, and the State of Tennessee providing funding for design, materials and construction of the seven new cabins at David Crockett State Park in Lawrenceburg. Additional funding for landscaping with native plants was provided by the Tennessee State Parks' Iris Fund. The cabins were completed in May 2010 and became available for public use in June 2010.

The USGBC's LEED certification program is the recognized standard for measuring building sustainability and a reliable method for demonstrating that a building project is truly "green." The USGBC rating system is designed to promote design and construction practices that reduce negative environmental impacts of buildings and improve occupant health and well-being. To achieve this certification, TDEC used sustainable design and construction processes that demonstrated:

- efficient water management
- healthy indoor air quality
- energy conservation
- pollution prevention, and
- use of environmentally friendly materials and resources in construction

The LEED program used to guide the build out for these vacation cabins is the same one used for private homes. In fact, most of the design, construction, materials, energy reduction and maintenance concepts used for these cabins can also be incorporated in a private home.

This Education Manual was developed to provide a high-level overview of the key sustainable design and construction features built into these new cabins. Detailed information regarding the heating and cooling system, radon protection system, and the product manufacturing manuals for installed equipment, fixtures and appliances are available for your information in the park office. The completed checklist for the LEED certification, a copy of signed accountability forms, and a copy of the durability inspection checklist are also available for review in the park office.

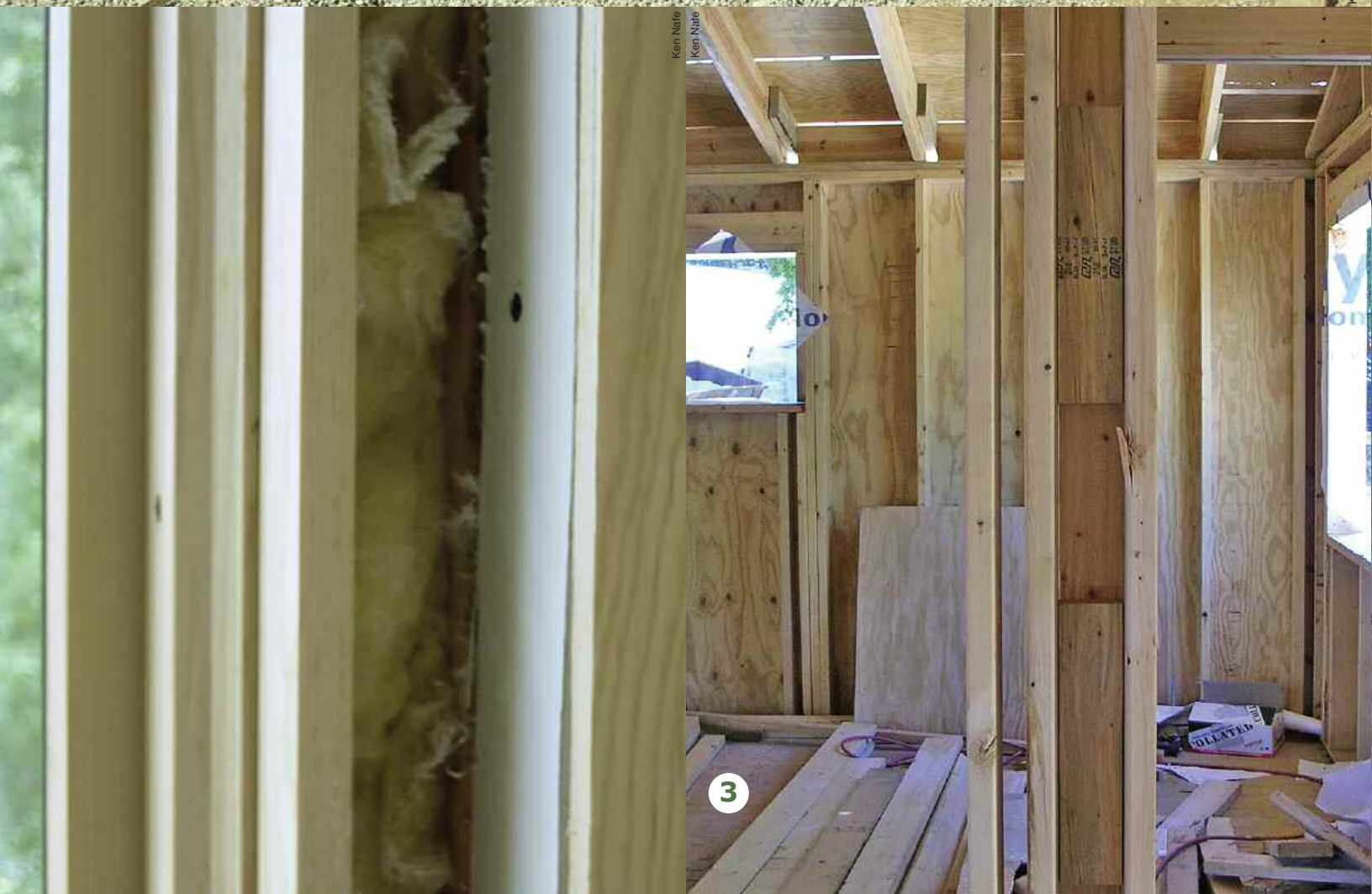


PROTECTING THE LAND



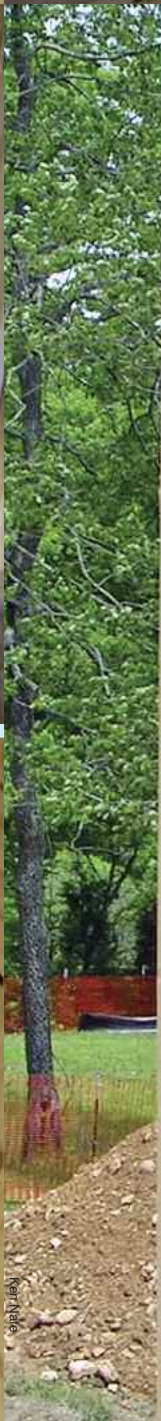
Material Efficient Framing

Material efficient framing uses 15 to 20 percent less material than traditional framing. Increasing the spacing for framing reduces the amount of wood used and the waste wood resulting for disposal in landfills. In addition, reduced framing can reduce the number and size of thermal breaks and increase the amount of insulation installed, leading to better energy performance.





For LEED certification the suggested framing should be greater than 16" O.C. (on center). For framing these cabins the ceiling joists, floor joists and roof rafter spacing was 24" O.C. Construction of two-stud corners instead of the more common three-stud corners, and ladder blocking for drywall attachment, were also used to reduce the amount of wood needed for framing.



Use Of Renewable Building Materials And Recycled Materials

The LEED program encourages use of environmentally preferable products (EPP) (recycled products, low emissions products, etc.) or building components that are extracted, processed and manufactured within the region (within 500 miles of cabin). The EPP used during construction include fiber cement siding made of 65 percent recycled materials, cork flooring and recycled plastic decking (Trex) for the porch and stairs.





Ken Nale

Kathy Glapa

The kitchen cabinets are made from white pine trees grown locally in Lawrence County. The cork flooring was made from cork oak trees, which is a rapidly renewable material. Recycled materials were used for insulation (35% recycle content), solid surface countertops, carpet (certified Green Label Plus and produced locally) and the wheel stops at the head of the parking areas.



Ken Nale

Recycling Waste

During construction, every practical effort was made to control waste. However, some waste materials were generated. These wastes included wood, cork flooring, siding, masonry materials, insulation, sealants, and paint. Each of these materials were disposed of properly when recycling was not an option.

Waste recycling containers are installed in the kitchen of each cabin for daily use by residents to encourage and facilitate household recycling. Recycled materials are collected from each cabin, placed in yellow bags outside the cabins for routine recycling pickup at the campground. Recycling is also conducted in other areas throughout the campgrounds and park.



PROTECTING THE WATER





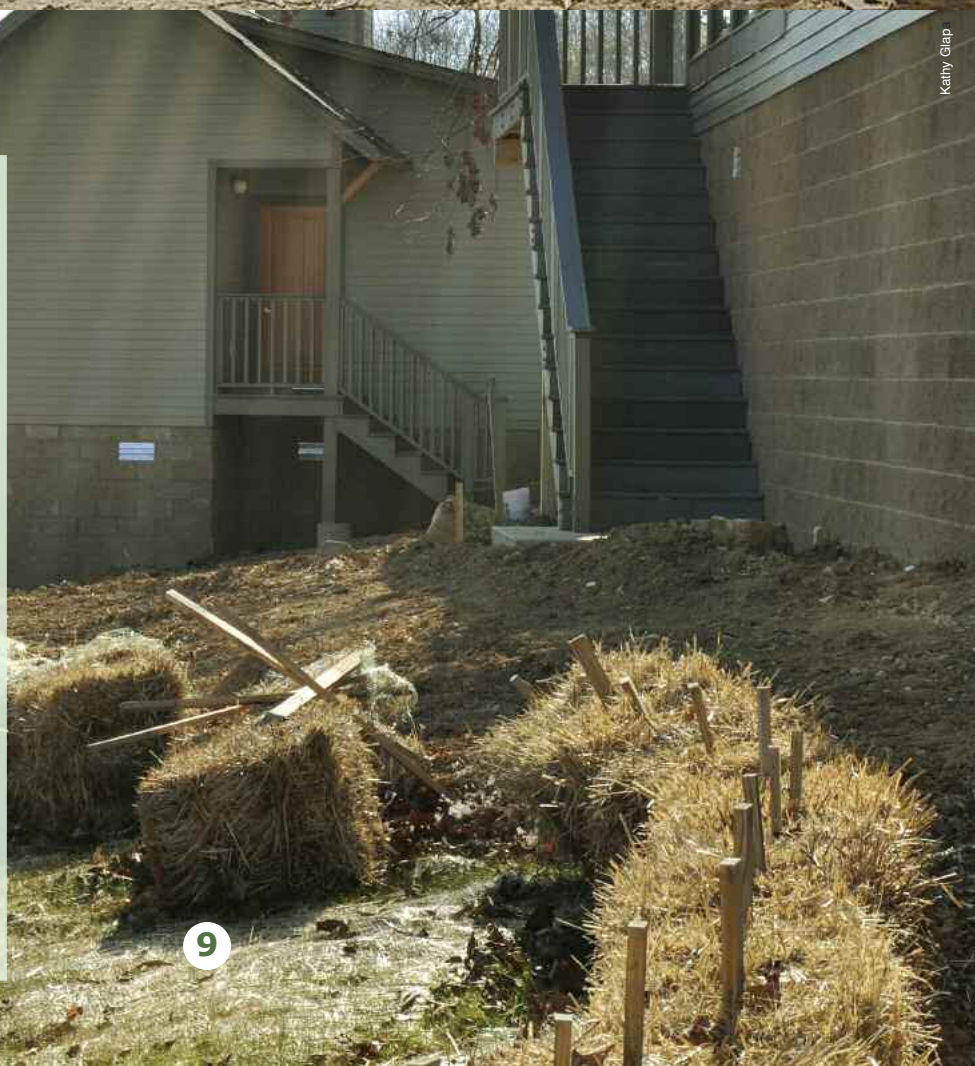
Surface Water Management During Construction

The cabins are constructed on a hillside to maximize views of the lake. During design and construction of the cabins, efforts were made to minimize disturbance to the site and control erosion from surface water runoff. Top soil was stockpiled and silt fencing was used to control the path and velocity of runoff.



Siltation

Silt is a fancy word for mud, and it's the single greatest cause of stream impairment in Tennessee. When rain falls on forests and meadows it runs clear and mud-free into our streams. But when rain falls on disturbed or bare ground, it creates a muddy runoff that chokes our streams, smothers sensitive habitats, kills aquatic species and hinders navigation. Silt builds up behind dams and suffocates our lakes. It also wreaks havoc with water treatment machinery by clogging intake pipes and damaging pumps. Silt comes from soil erosion around road-building projects, urban construction sites, and cultivated farm fields.





Straw bales and swales were used to direct runoff flow away from sewer inlets and the lake. Areas of natural vegetation were marked for preservation and “no disturbance” zones were clearly marked to minimize impacts to the site during construction activities.



Permanent Surface Water Management And Erosion Control

The cabins are located on the hillside overlooking the lake. Siting and long-term landscaping design considerations were incorporated into the overall plans for constructing the cabins. A white gravel porous surface material was used in constructing the driveways used for the cabins. This material allows surface water to filter through and be absorbed into the ground for irrigation and recharge to groundwater. This pervious surface minimizes erosion as less surface water flows down the hill from the cabins towards the lake.



Hasings Architecture Associates, LLC

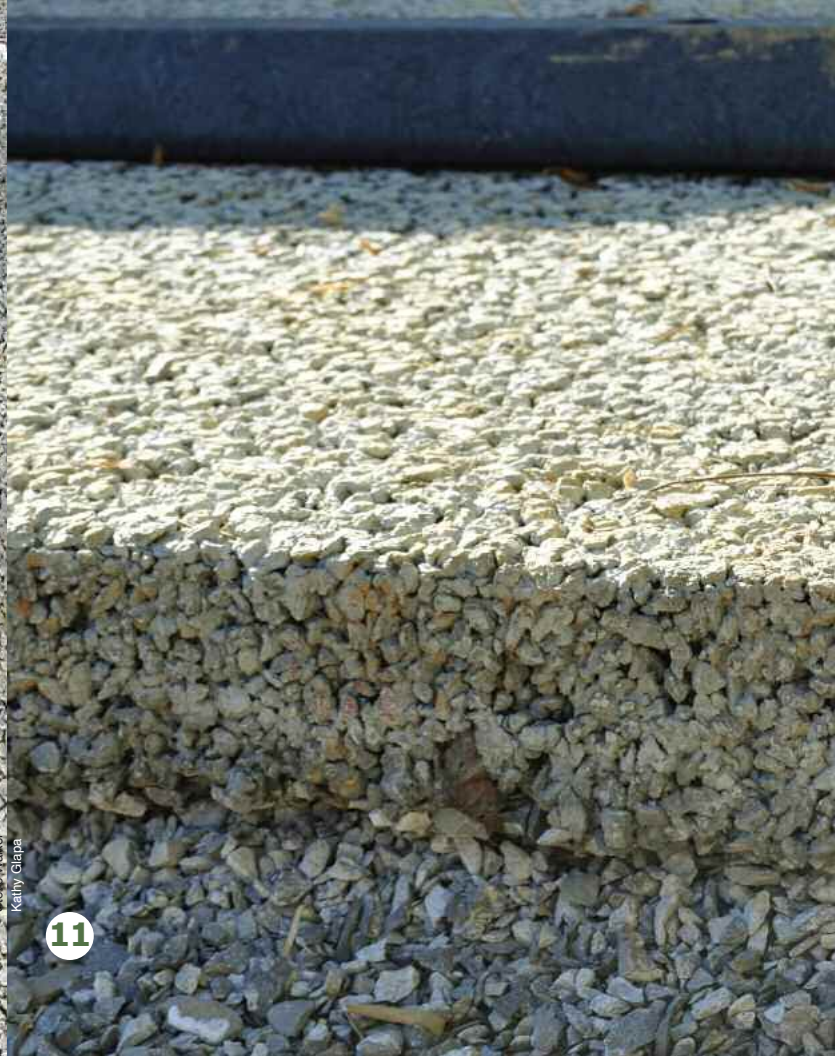
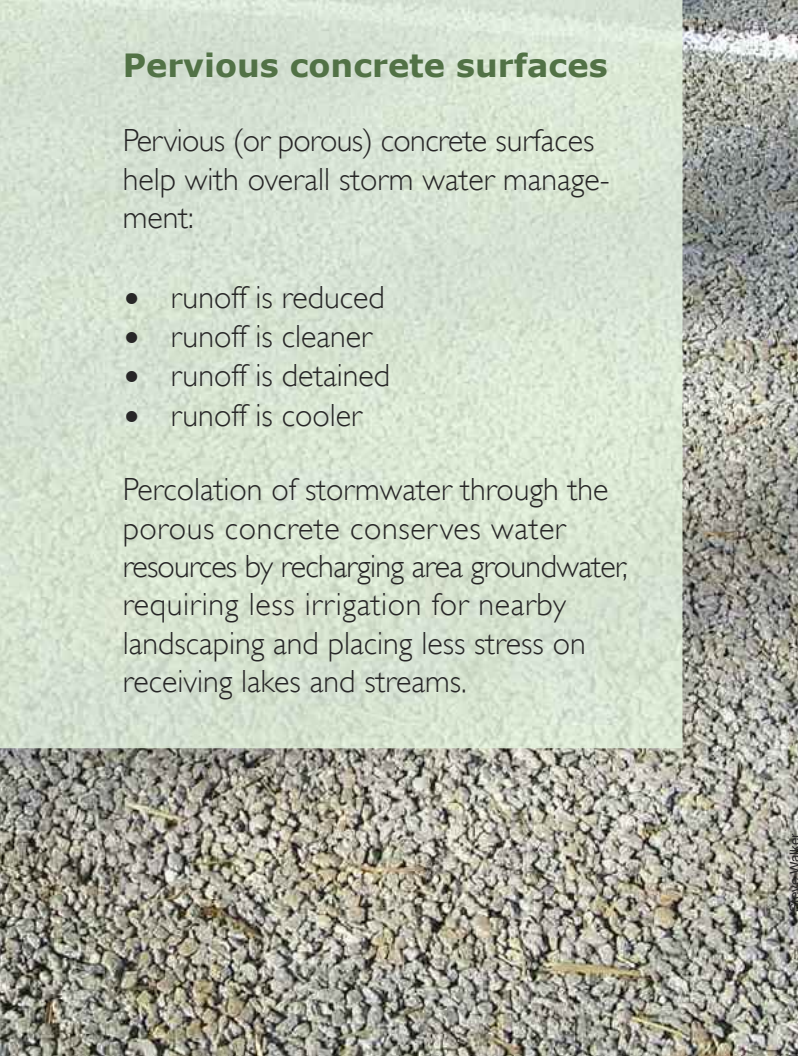


Pervious concrete surfaces


Pervious (or porous) concrete surfaces help with overall storm water management:

- runoff is reduced
- runoff is cleaner
- runoff is detained
- runoff is cooler

Percolation of stormwater through the porous concrete conserves water resources by recharging area groundwater, requiring less irrigation for nearby landscaping and placing less stress on receiving lakes and streams.



Steve Walker
Kathy Glapa



Unique features for surface water control at the site are the rain gardens. They are designed and constructed for surface water to be directed into them. The water collected in the rain gardens is contained and allowed to infiltrate into the ground while silt is filtered out of the water. This prevents silt and other materials from washing into the lake during rain events.

In addition, rain barrels are located at each cabin to collect rainwater. They facilitate collection of rainwater from cabin roofs when attached to downspouts. Collection of this water will minimize runoff and erosion during storm events and be used for local landscape irrigation at the cabins via soaker hoses.





Kathy Glaspie
Jed Dekalb

Landscaping

The cabins are located on a hillside facing the lake. The slope of the hillside is significant enough to pose potential runoff and erosion concerns. To address this, a landscaping plan was developed for the site that allows for use of native plants with addition of select drought-tolerant turf and plants.



Jed Dekalb



The Iris Fund

Tennessee State Parks' Iris Fund supports landscape projects that establish or re-establish native trees, flowers, plants and shrubs at park locations. Plantings done through the Iris Fund provide wildlife habitat, control erosion, stabilize stream banks, and often serve to teach park visitors about the natural history of the area. The Fund also supports removal of invasive exotic plants and installation of low maintenance trees, native plants and grasses that demand less maintenance.



Financial support for the Iris Fund comes from the sale of attractive specialty license plates highlighting Tennessee State Parks and our state flower, the iris. These voluntary license plate purchases demonstrate motorists' support for state parks and also contribute to beautifying our park locations through "on the ground" Iris Fund investments.

Native Species

A species native to a particular region of the state is one that is thought to have lived here before human settlement. Exotic species usually come from another country, but for state park purposes, a plant is non-native even if it comes from another part of the country. An example of an invasive exotic plant or species is kudzu. Native species require less maintenance since they are adapted to the climate and soils. Since state parks promote Tennessee history, it is fitting that we promote the state's natural history as well. Our native plantings provide the visitor the opportunity to see species such as the state tree, tulip poplar, as well as popular species such as dogwoods, oaks, azaleas, coneflowers, and ferns.

The Iris Fund provided significant resources for landscaping with native plants around and between the new cabins at David Crockett State Park. Species were chosen based on whether they are native to the southern middle Tennessee region of the state.



Water Conservation

Water conservation at the cabins includes both maximizing outside water reuse and minimizing indoor water use. Use of rain barrels will enable rainwater to be reused for local landscape watering near the cabins via soaker hoses. Reduced indoor water use is accomplished with use of high performance lavatory and shower faucets and dual-flush toilets, using either 0.6 or 1.2 gallons per flush, as needed.



Steve Walker



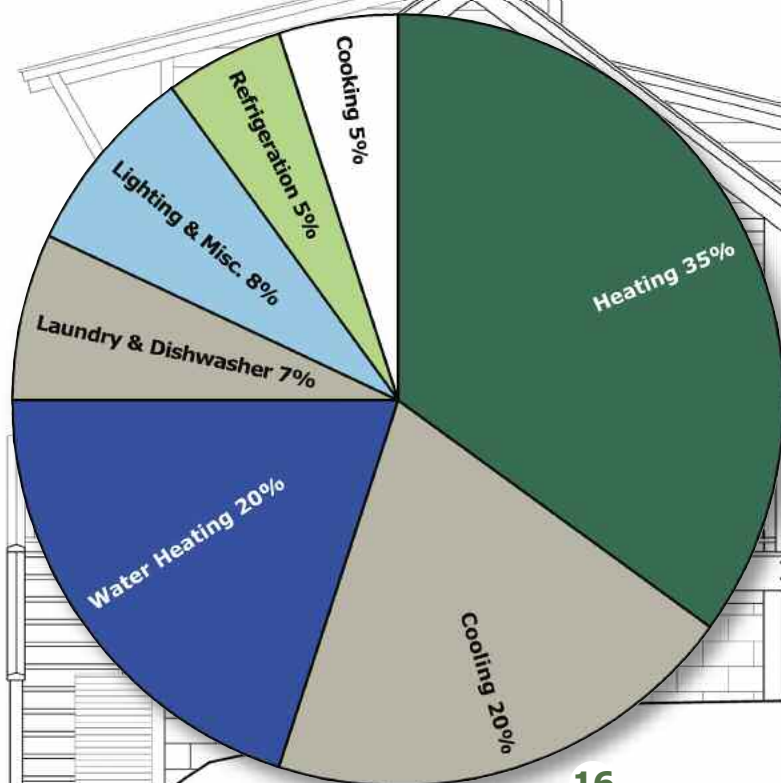
Ken Male
Kathy Glapa



CONSERVING ENERGY



energyright[®]
solutions



Geothermal Heating and Cooling System

The cabins and the restaurant use the surface water ground heat exchanger method using the lake as the heat source. The fluid flows through the loop pipes that are anchored at the bottom of the lake. The individual pipe coils are combined into a single circuit and are attached to a frame. The frame was floated on the lake to the desired location, filled with fluid and sunk. Concrete blocks anchor the frame to the bottom. The frame keeps the pipes slightly elevated above the bottom surface to promote circulation and to prevent sediment from covering the pipes. The loosely coiled piping allows water to flow across the bundle which creates the temperature difference between the pond water and the pipe fluid. Lake systems work well in heating because the water is at its highest density at 39°F. The water around the pipes at the bottom of the lake is sufficiently above freezing for extracting heat easily. The system takes advantage of this by exchanging heat with the earth. Since fossil fuel is displaced in the winter heat pump application, and summer heat pump operation only occurs occasionally, more efficient loop temperatures can be achieved. This results in more consistent electrical demand throughout the year and lower electricity costs.



The geothermal heat pump has many advantages. The closed-loop heat pump system also works to heat water in the hot water heater so heating water in the summer is essentially free. Use of low-flow showerheads and faucets will also reduce demand for hot water and lower resulting energy use for water heating.

The geothermal system has low operating and maintenance costs, reduces emission of greenhouse gas and is quiet. It also has great long-term value. The system has been designed and constructed to allow additional cabins or other buildings to be added to the system as needed or desired in the future.

The heating and cooling distribution system is appropriately designed and insulated to provide thermal comfort with minimized waste. In addition, in the hot and humid climate, effective dehumidification significantly reduces cooling loads. A humidity regulator and monitor are installed in each cabin.



ENERGY STAR Appliances, Lighting, Fans And Windows

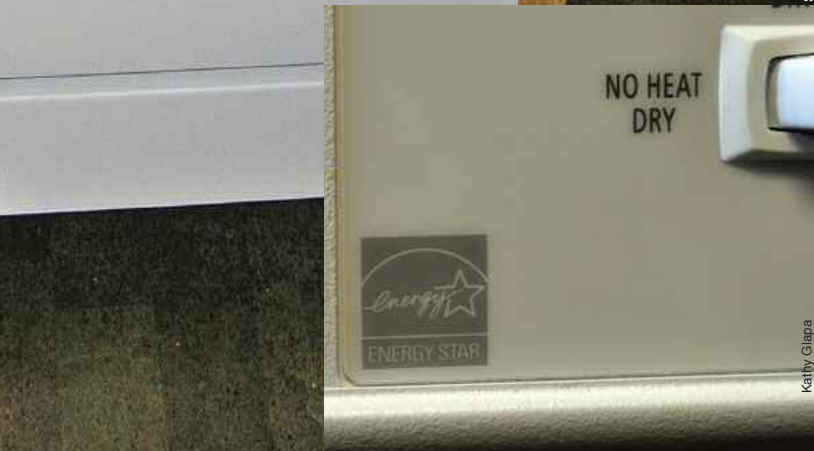
The EPA and US Department of Energy ENERGY STAR program was established as a system to label products with technology, design, and performance that meet minimum energy efficiency requirements. Use of ENERGY STAR products saves approximately one-third on energy bills for typical homes while reducing use of energy and protecting the environment. The list of products includes appliances, lighting fixtures and windows.



Kathy Glapa
Kathy Glapa

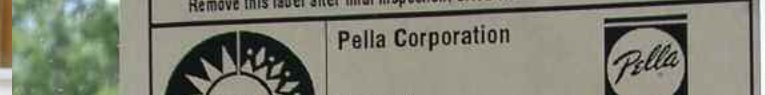


Steve Walker



Kathy Glapa
Kathy Glapa





ENERGY STAR-rated appliances have been installed in the cabins, including refrigerator and dishwasher. ENERGY STAR windows have been installed, as well as ENERGY STAR ceiling fans in the living area, bedrooms and on the deck. The windows are made with low E (low Emissivity) glass, and windows with direct exposure to the sun are double-pane. They allow visible light in – reducing the need for artificial lighting – but have a reflective coating to keep heat inside when it is cool outside and prevent over heating the exterior when it is warm outside. ENERGY STAR lights and exhaust fans have been installed in the restrooms, and lights in the cabins contain energy efficient light bulbs as well.



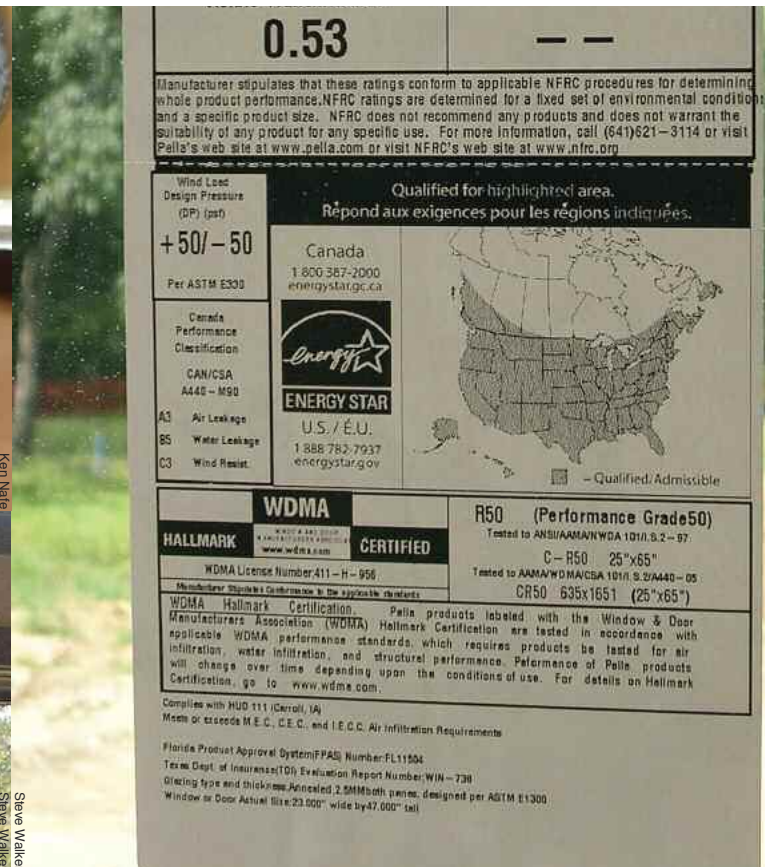
Ken Nale



Steve Walker
Steve Walker



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Energy Right® Solutions Construction

The TVA Energy Right® Solutions program is designed to provide certification that the builder has worked in a cooperative effort with TVA and local utility services to invest in the most efficient energy design and construction options. During construction of these cabins, TDEC worked with Lawrenceburg utility systems and TVA to address energy saving issues.

These included:

- maximizing insulation in walls, ceilings, and floors
- installing wall and continuous floor vapor barriers
- installing low energy, double pane windows and energy efficient doors
- ventilating of crawl space and roof
- installing an energy efficient heating and cooling system, heat pump and hot water heater
- weather-sealing appropriate areas during construction and installation
- using energy efficient lighting and appliances
- installing a fireplace in the cabin that is also rated energy efficient and has permanently fixed doors



Ken Nafe
Steve Walker

Steve Walker
Steve Walker



Steve Walker
Ken Nale

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INSULATE

1. Ceilings (attic floors and cathedral)
2. Above Grade Walls
3. Conditioned Basement Walls
4. Framed Floor
5. Slab-on-Grade (edge and under)
6. Heating and Cooling Ducts (non-conditioned)
7. Attic / Knee Wall

INSTALL

8. Damper on Exhaust Fan Vent
9. Continuous Wall Vapor Barrier
10. Continuous Floor Vapor Barrier
11. Crawl Space Ground Cover
12. Crawl Space Ventilation
13. Hi-Low Attic / Roof Ventilation
14. Energy Efficient Windows (double pane, low-E, etc.)
15. Energy Efficient Doors (solid wood, foam core, etc.)

16. Weathersealing (caulk, sill plate sealer, etc.)
17. Energy Efficient Heat Pump (high SEER & HSPF ratings, etc)
18. Energy Efficient Electric Water Heater (high energy factor)
19. Energy Efficient Fireplace (backdraft damper; sealed combustion-air, etc)

Siting and General Layout of Cabins

Cabins are oriented north-south to maximize views of the lake and optimize solar heat and gain. Each has an open floor plan with vaulted ceiling and many windows for natural lighting. Cabins have large covered decks and sun shades on windows that allow for passive solar shading and heating. The sun shades function to block or shade the high summer sun shining directly to the interior of the cabin through the glass. This prevents heat gain in the summer months. In the winter, due to the sun's lower angle of inclination, the light enters and helps to keep the cabin warm.



Kathy Glapa



Joe Dekalb

PROTECTING THE AIR

Hastings Architecture Associates, LLC



Potential Outdoor Air Quality Impacts

The geothermal heating and cooling system operation has minimal impact on air quality. The system is submerged in the lake and has no emissions of carbon dioxide to the ambient air, unlike most typical HVAC systems.



Ken Nale

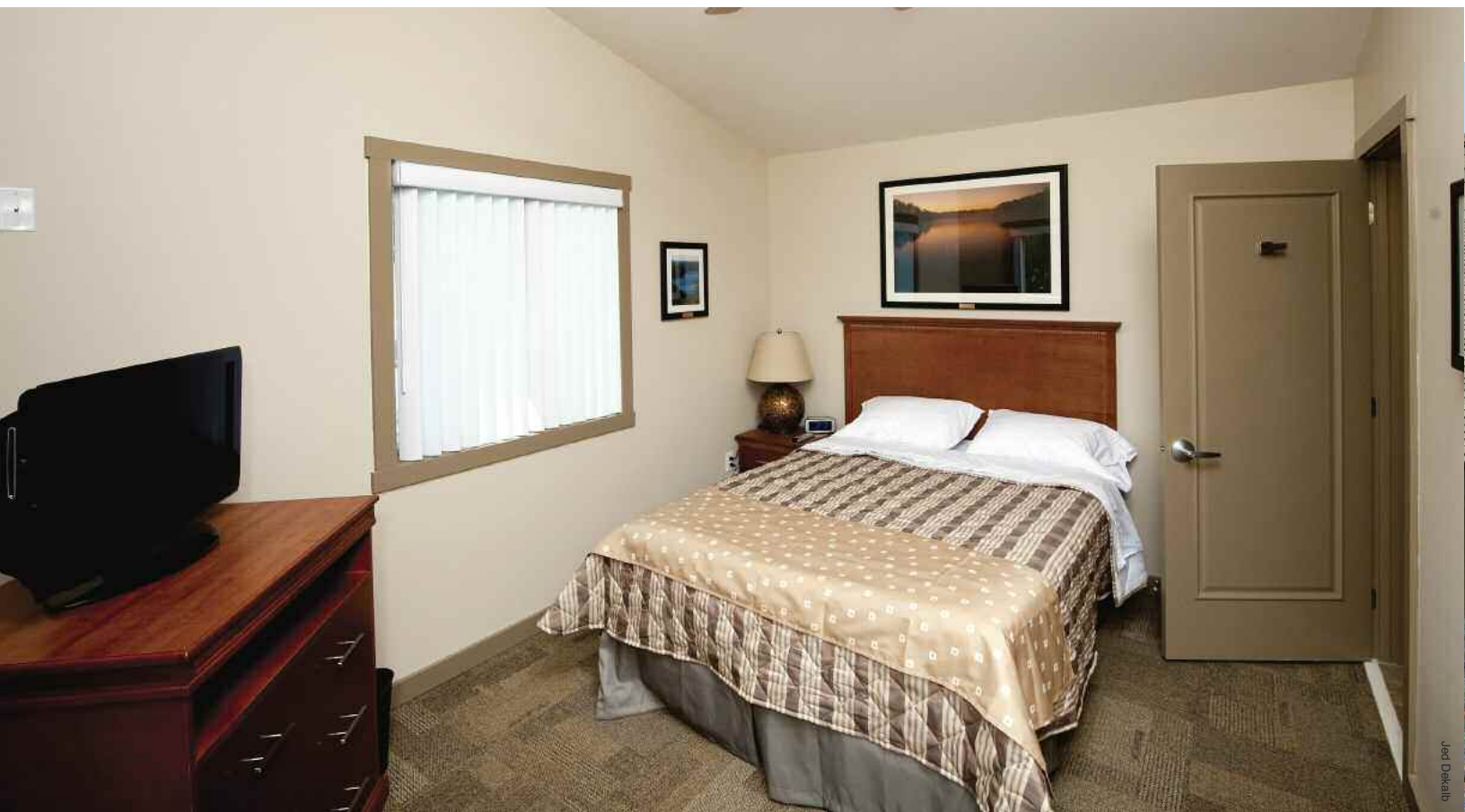


Potential Indoor Air Quality Impacts

Several considerations were given to maximizing good indoor air quality in the cabins during construction and long-term operation. During construction, caulking was done throughout to seal openings as well as sealing windows and doors. This prevents intrusion of unwanted outdoor air. The fireplaces installed are energy efficient and have permanently fixed doors to minimize air intrusion. Multi-speed ceiling fans were installed in the living area and bedrooms to facilitate circulation of indoor air. The windows were installed to be operable and allow influx of fresh air into the cabins.



The paints, adhesives and sealants used throughout the building give off zero or low levels of harmful or volatile organic compounds. The interior cabinets are made with no added urea formaldehyde resin materials. During construction, a passive radon venting system was installed in each cabin to prevent radon gas from entering the cabins.



Radon Venting System

A radon venting system designed and constructed consistent with radon resistant new construction techniques was installed in each cabin. These systems passively remove radon gas from soil beneath the cabins to the outside so it will not be harmful to cabin occupants.

About Radon

Radon is a naturally occurring radioactive gas. It is released during the natural decay of uranium, which is found in most rock and soil. Radon is odorless, invisible and without taste. Although certain areas of the state have higher levels of radon than others, radon has been detected in every county in Tennessee.

Radon and its decay products release radioactive energy that can damage lung tissue in a way that causes the beginning of lung cancer. The more radon you are exposed to, and the longer the exposure, the greater the risk of eventually developing lung cancer. Radon is the second leading cause of lung cancer in the United States, resulting in 15,000 to 22,000 deaths per year.



Kathy Glapa



Ken Nide
Steve Walker

Green Construction Materials and Chemical Use

The impacts to indoor air quality from construction materials were minimized by constructing cabins with use of low volatile organic paints and adhesives. Carpets containing low volatile organic compounds were installed in the bedrooms.

Cleaning of cabins is conducted with use of "green" chemicals to minimize the introduction of odors and harmful chemicals into the cabins.



State Parks Leave a Lighter Footprint for Tennessee

Along with providing memorable outdoor experiences for families and friends, Tennessee State Parks take action to promote sustainability and environmental stewardship at park locations across the state:

We purchase **renewable Green Power** for all the parks where TVA's Green Power Switch is available.

We deployed **major energy efficiency investments** at Henry Horton, Pinson Mounds and Sycamore Shoals that are resulting in significant operational cost reductions and removing more than one million pounds of greenhouse gas annually.

We have six **certified Clean Marinas** at Edgar Evins, Norris Dam, Paris Landing, Pickwick Landing, Tims Ford and Warriors' Path that protect the health and safety of the boating public by reducing pollution on Tennessee's rivers and lakes.

We have three **state park golf courses certified by Audubon International** for their environmental and wildlife achievements. Three of these courses have also attained **recognition as Groundwater Green Guardian sites** for their achievements in water quality and conservation.

Montgomery Bell opened **eight new cabins certified TVA energy right** in 2009.

David Crockett opened seven new cabins in summer 2010 that achieved **Leadership in Energy and Environmental Design (LEED) Silver certification** from the U.S. Green Building Council.



**Green Power
Switch Purchasers**



**Major Energy
Conservation
Projects**



**Clean
Marinas**



**Audubon
International
Certified Golf Courses**



**Groundwater
Green Guardian
Site**



**LEED
Silver Certified
Vacation Cabins**

The Tennessee Department of Environment and Conservation and Tennessee State Parks have partnered with the Tennessee Department of Tourist Development to support **Tennessee Sustainable Tourism**, an initiative designed to preserve and protect our state's unsurpassed natural beauty while encouraging the growth of the tourism industry in Tennessee.



